CAM-IES: Centre for Advanced Materials for Integrated Energy Systems

£2.4M funding for an EPSRC Networking Centre + £1.4M Matching from Industry Joint Centre involving Cambridge, Newcastle, Queen Mary and UCL. 400k earmarked for networking activities

Start Date: 1 December 2016

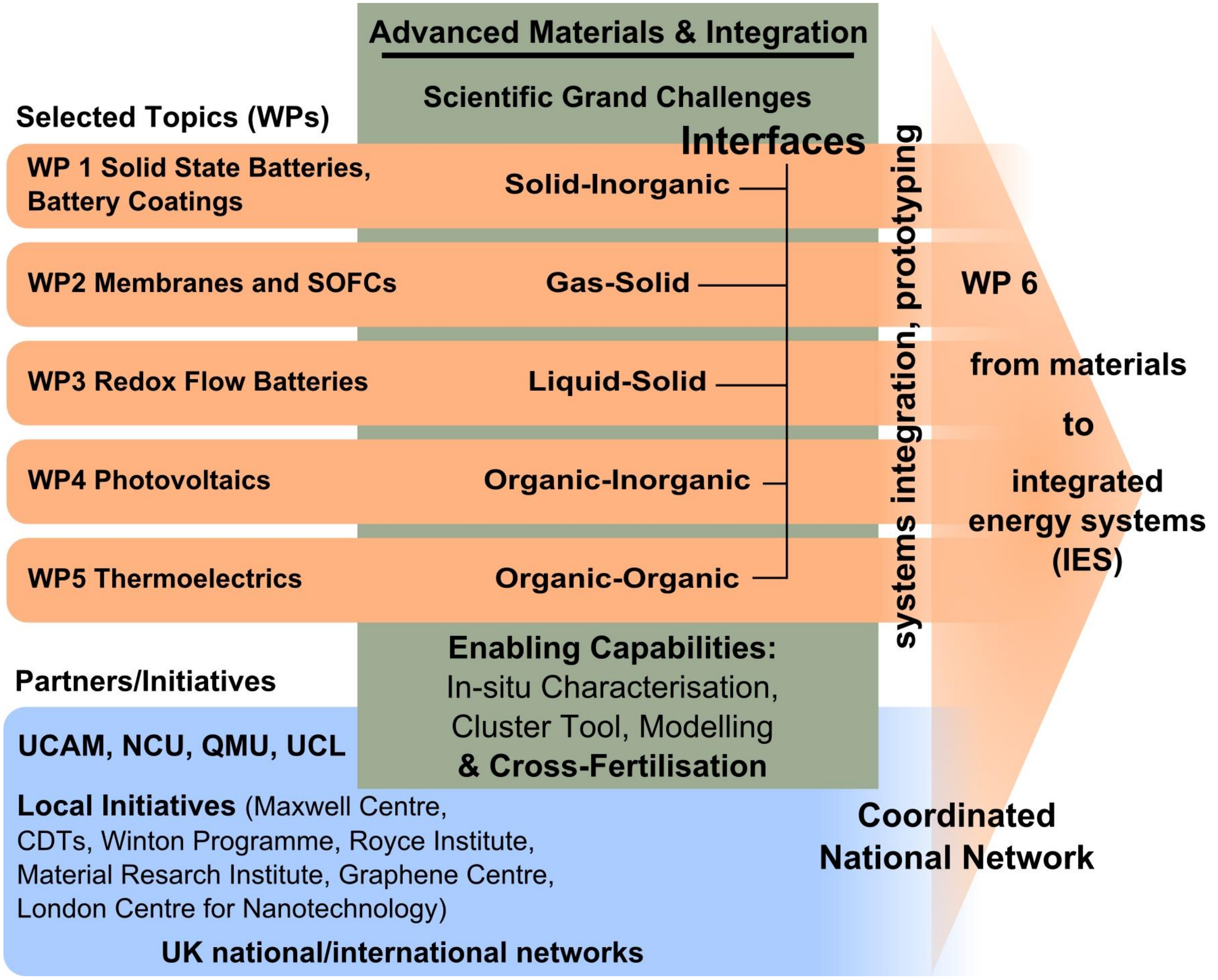
Objectives:

- To create a UK-based community of researchers focused on materials for Integrated Energy Systems.
- Facilitate access to experimental facilities for interested users, in particular unique tools for energy materials characterization and deposition that are currently being set-up in Cambridge as part of the Sir Henry Royce Institute.
- Develop advanced materials for energy storage, specifically solid-state batteries, coatings for high voltage electrode battery materials, and flow batteries, and energy conversion, specifically solid-oxide fuel cells, CO_2 gas separation membranes, hybrid thin film photovoltaics and large-area thermoelectrics
- Help identify new research direction, working closely with industry

CAM-IES: Centre for Advanced Materials for Integrated Energy Systems

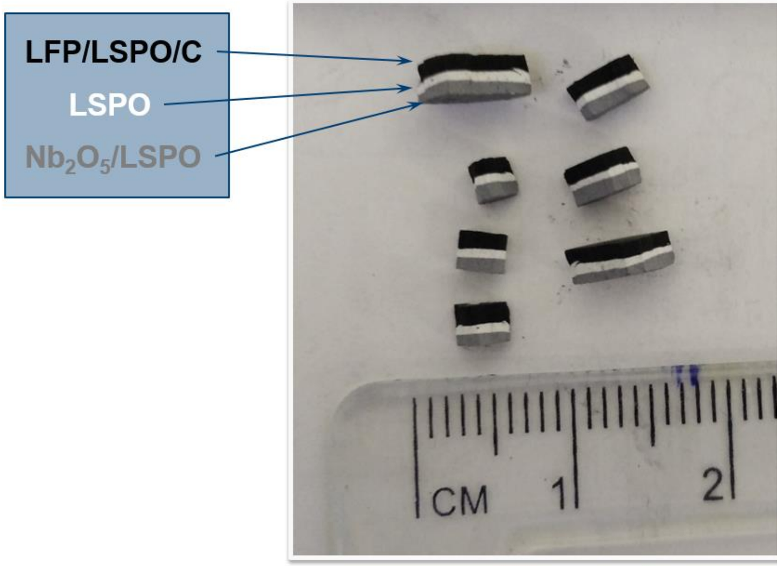
Chemistry:	**Prof Clare P. Grey (Director and PI)**
CAM COIs: Dept. of Materials Science:	**Prof Judith Driscoll**
	Dr. Sohini Kar-Narayan
Cavendish Laboratory:	**Dr Siân Dutton**
	Prof Sir Richard Friend
	Prof Henning Sirringhaus (Co Director)
Dept. of Engineering:	**Dr Stephan Hofmann**
Newcastle University:	**Prof Ian S. Metcalfe (Co Director)**
QMU:	**Prof William Gillin**
	Dr Christian Nielsen
UCL:	**Dr Hugo Bronstein**
	Prof Franco Cacialli

CAM-IES: Centre for Advanced Materials for Integrated Energy Systems



CAM-IES: Centre for Advanced Materials for Integrated Energy Systems

WP1 – Solid-solid inorganic electrolyte-electrode interfaces for solid state batteries, battery coatings and SOFCs (Lead: Judith Driscoll)



SPS-prepared solid-state batteries with LSPO electrolytes

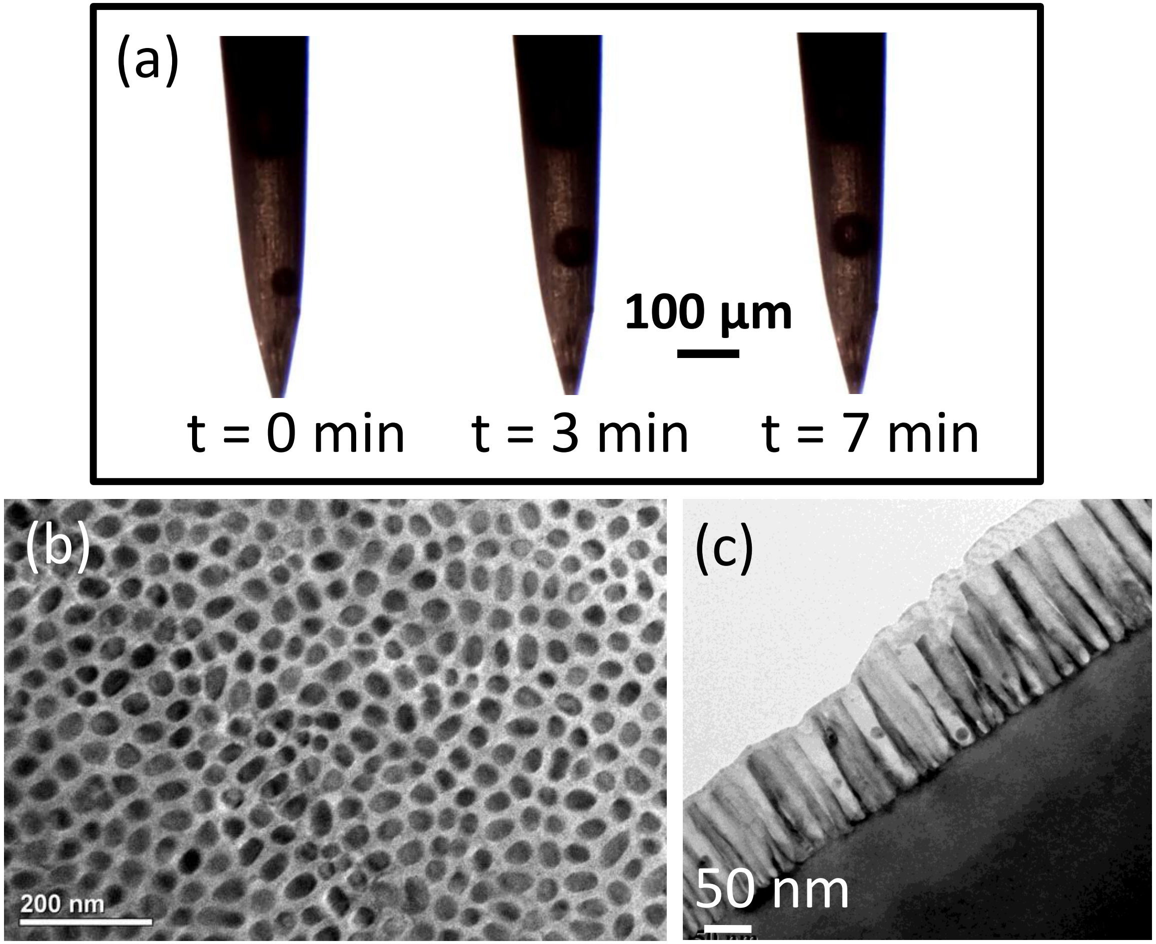
One of the goals of WP1 is to understand the relevant chemical and electrochemical processes at solid electrolyte-electrode interfaces using ideal epitaxial systems.

Studies of perfect single crystal interfaces of complex compositions are normally undertaken by the oxide electronics and physics communities, but there is enormous, as yet, untapped potential for the basic understanding of interfacial processes for electrochemical energy technologies.

CAM-IES: Centre for Advanced Materials for Integrated Energy Systems

WP2: Gas-solid interfaces: Membranes for gas separation and solid oxide fuel cells (Lead: Ian Metcalfe)

This WP will develop new materials for solid membranes for CO_2 gas separation and SOFCs. Both rely on efficient oxygen ion transport through the solid membrane separating two gases of different composition.



(a) Visualisation of growth of a CO_2 bubble with time in model membrane

(b) SEM plan-view (b) and cross section (c) of epitaxial membrane

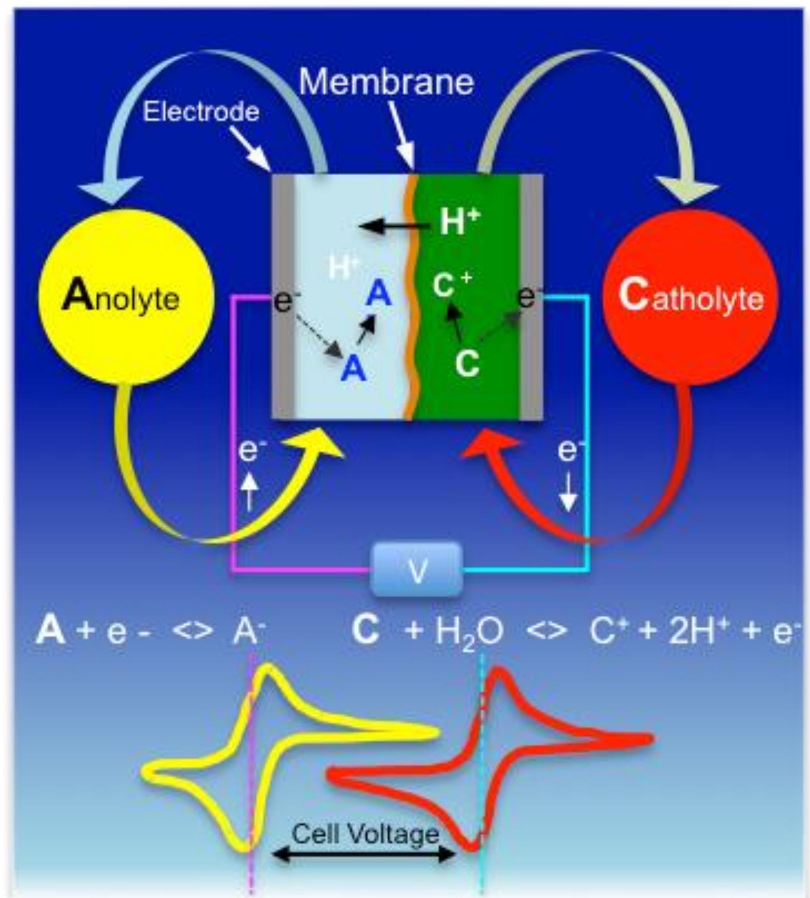
CAM-IES: Centre for Advanced Materials for Integrated Energy Systems

WP3 Liquid - solid interfaces for redox flow batteries (Lead: Clare Grey)

Our approach will target the substitution of costly Vanadium based redox-flow batteries (VRFB) by using low cost and environmentally friendly organic and inorganic systems as redox active electrolytes.

Focus on both new materials and new electrode structures.

Synthesise and study redox active molecules capable of 2 or more electron redox processes



CAM-IES: Centre for Advanced Materials for Integrated Energy Systems

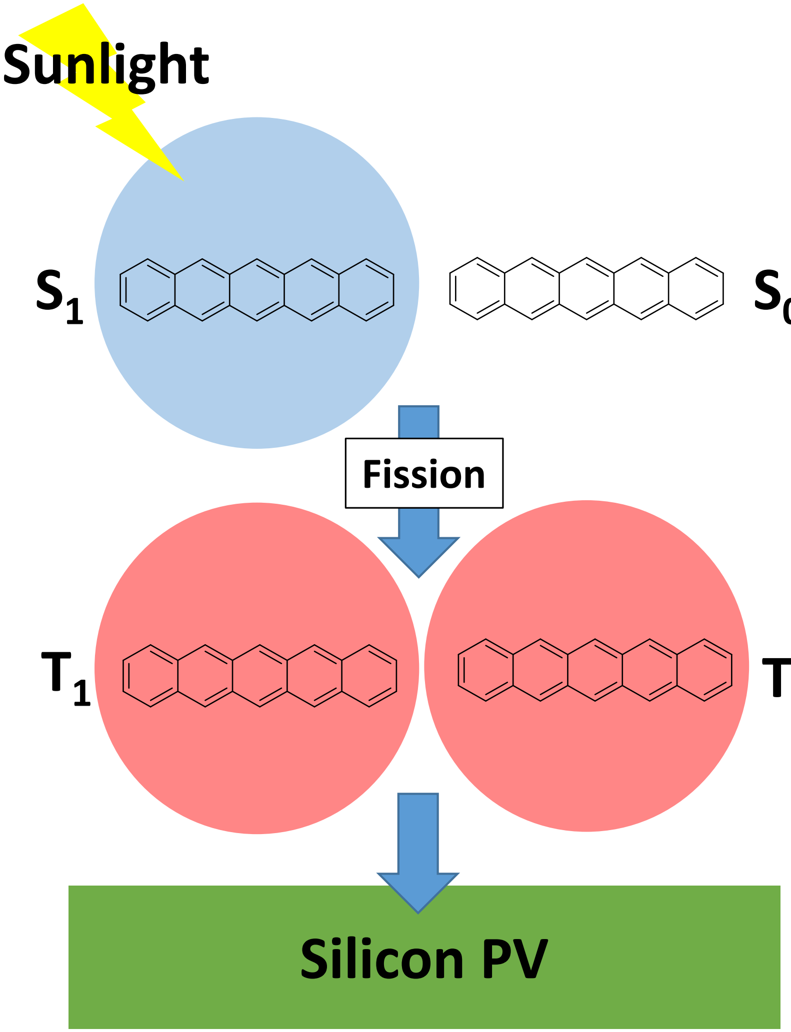
WP4 Organic-inorganic hybrid interfaces - Spin triplet excitons for photovoltaics (Lead: Hugo Bronstein)

Splitting of spin-singlet excitons into two spin-triplet excitons each of half the singlet energy (‘singlet fission’) provide a very efficient means to down-convert high energy visible photons to near-IR photon pairs that may be then harvested in a semiconductor with near-IR bandgap.

Shockley-Queisser efficiency limit can potentially be overcome.

Aim to boost the efficiency of standard silicon solar cells using an add-on layer to double the current collected from green and blue photons.

.



singlet fission PV schematic

CAM-IES: Centre for Advanced Materials for Integrated Energy Systems

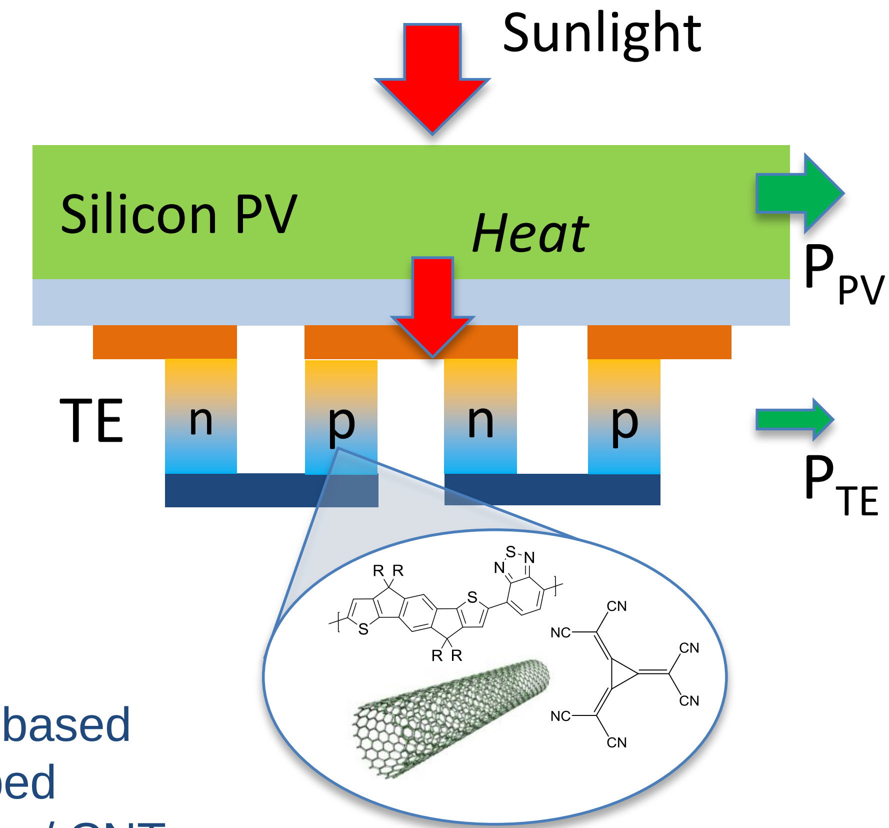
WP5 Organic heterointerfaces – New materials for efficient, large-area thermoelectrics (lead: Henning Sirringhaus)

Conventional Bi_2Te_3 thermoelectrics are unlikely to be suitable for large-area applications due to the relative scarcity of their elements in the earth's crust.

Here we will develop thermoelectrics of comparable efficiency based on low-cost, earth-abundant materials.

Hybrid materials are attractive because they facilitate optimizing a material simultaneously for high Seebeck coefficient, high electrical conductivity, but low thermal conductivity.

We will focus on conjugated polymer-carbon nanotube (CNTs) composites.



STEG based on doped polymer / CNT composites

CAM-IES: Centre for Advanced Materials for Integrated Energy Systems

WP6 – From new materials to integrated energy systems (lead Richard Friend)

We will perform a larger-scale evaluation of the performance, reliability as well as application potential that will enable us to engage effectively with industrial partners and identify exploitation opportunities.